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ABSTRACT

This report was prepared to assist the United States Army in evaluating the usefulness of readability formulas in identifying material that will be comprehended by readers at a given reading skill level. Existing readability methods and research findings were reviewed against three major criterion questions and the findings are discussed. The conclusions reported are: (1) readability formulas cannot match material to readers at targeted reading grade levels, (2) rewriting to lower the formula reading grade level score does not increase comprehension, and (3) requiring that text be written to satisfy a targeted reading grade level score focuses attention on meeting the score requirement rather than on organizing the material to meet the readers' information needs. An approach is outlined for developing a broader based method and criteria to bypass the deficiencies of present readability formulas. It is suggested that an Army readability standards checklist should be developed that would include such items as visuals and organization of content as well as sentence length and word difficulty. The appendix includes a special report, prepared in 1974, summarizing interviews with Army writers of training manuals. (MKM)

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Technical Report 437

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USEFULNESS OF READABILITY FORMULAS FOR ACHIEVING ARMY READABILITY OBJECTIVES: RESEARCH AND STATE-OF-THE-ART APPLIED TO THE ARMY'S PROBLEM

Richard P. Kern

TRAINING TECHNICAL AREA

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This report was prepared to assist the Army in evaluating the usefulness of readability formulas in identifying material that will be comprehended by readers at a given reading skill level.

Existing readability methods and research findings were reviewed against three major criterion questions. These questions and conclusions reached for each are as follows:

1. Question: How effectively do formulas predict comprehension at targeted reading grade levels?

Conclusion: Formulas cannot match material to reader.

2. Question: Does rewriting to lower readability scores increase comprehension?

Conclusion: Rewriting to lower the formula reading grade level score does not increase comprehension.

3. Question: How will formula score requirements affect production of written materials?

Conclusion: Requiring that text be written to satisfy a targeted reading grade level score focuses attention on meeting the score requirement rather than on organizing the material to meet the readers' information needs.

An approach is outlined for developing a broader based method and criteria to by-pass the serious deficiencies of present day readability formulas.

Technical Report 437

USEFULNESS OF READABILITY FORMULAS FOR ACHIEVING ARMY READABILITY OBJECTIVES: RESEARCH AND STATE-OF-THE-ART APPLIED TO THE ARMY'S PROBLEM

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FOREWORD

The Training Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) conducts a program of research in support of the systems engineering of training. A major part of this research is to develop the fundamental data and technology necessary to put into the field integrated systems for improving individual job performance. Such systems include Skill Qualification Testing (SQT), job performance aids, training courses in schools and in the field, performance criteria, and management and feedback systems.

This report was prepared in response to a request for Technical Advisory Service from Director of Evaluation, US Army Administration Center, Fort Benjamin Harrison, Indiana. This request was for technical assistance in evaluating and identifying methods that will assist the Army in achieving objectives for improved readability of Army publications.

This review focuses on a specific methodological problem basic to job aid research currently being conducted under Army Project 2Q162722A777, Training Technology.

JOSEPH ZEIDNER
Technical Director

USEFULNESS OF READABILITY FORMULAS FOR ACHIEVING ARMY READABILITY OBJECTIVES: Research and State-of-the-Art Applied to the Army's Problem

BRIEF

Requirement:

Evaluate existing methods for determining readability of written materials, and determine the most effective method for achieving Army readability objectives.

Procedure:

Existing readability methods were reviewed against three major criterion questions presented below with conclusions. This review was based on the existing research literature. Data were obtained from research reports on the development and revision of a number of readability formulas. These data were used to examine the extent of agreement between readers' comprehension test scores and the reading difficulty level score obtained by applying readability formulas to the same passages. In addition, research was reviewed on the effects of rewriting text to improve ease of comprehension.

Findings:

Question: How effectively do formulas predict comprehension at targeted reading grade levels?

Conclusion: Formulas cannot match material to reader

Current readability formulas provide unreliable predictions of reading skill levels at which text can be comprehended and are therefore unsuitable for meeting Army readability objectives.

Example: Text comprehended by readers with 7th to 8th grade reading skills may yield formula readability scores ranging from the 3rd to 11th grade levels. Text understood by readers with 9th to 10th grade reading skills may yield formula scores ranging from the 6th to the 12th reading grade levels.

Current readability formulas appear most reliable when used to make a gross screening distinction between material that is above or below about the 10th grade difficulty level. Soldiers who read below the 10th grade skill level will generally not be able to readily comprehend text that scores above the 10th grade difficulty level.

Question: Does rewriting to lower readability scores increase comprehension?

Conclusion: Rewriting to lower the formula's reading grade level score does not increase comprehension.

Research reviewed indicates that rewriting text to reduce its reading difficulty level (formula score) by using shorter words and sentences to "say the same thing" does not result in corresponding increases in readers' comprehension.

Question: How will formula score requirements affect production of written materials?

Conclusion: Requiring that text be written to satisfy a targeted reading grade level score focuses attention on meeting the score requirement rather than on organizing the material to meet the readers' information needs.

Criteria used to identify writing that meets readability standards should be criteria that writers and editors can be encouraged to use as a guide to detect problems and improve their text. Present day readability formulas cannot provide this guidance. By shifting attention from content features to formula scores, readability standards may even promote production of writing that is harder to understand.

Utilization:

This report presents an approach for developing a broad-based method for establishing readability standards and for evaluating proposed publications against these standards. This method will address the following objectives readability formulas cannot address:

(1) Provide a method and criteria writers and editors can use to develop and improve their material.

(2) Identify specific kinds of problems present when material does not meet standards.

(3) Apply to illustrations and all other parts of a publication. (Readability formulas can only be applied to passages of written text).

USEFULNESS OF READABILITY FORMULAS FOR ACHIEVING ARMY READABILITY OBJECTIVES: RESEARCH AND STATE-OF-THE-ART APPLIED TO THE ARMY'S PROBLEM

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USEFULNESS OF READABILITY FORMULAS FOR ACHIEVING ARMY READABILITY OBJECTIVES: RESEARCH AND STATE-OF-THE-ART APPLIED TO THE ARMY'S PROBLEM

BACKGROUND

Department of the Army has undertaken a long-range program to improve the Army publication system. A major objective of this program, improving the readability of Army publications, is addressed by Department of the Army Circular 310-9 (15 December 1978). This circular prescribes use of readability formulas as the major method for determining when readability objectives have been met for a proposed publication. Commanding General, US Army Administration Center (ADMINCEN), and The Adjutant General are tasked in this circular to review existing methods for measuring readability and to develop a single method for use in preparing Army publications. The present paper was prepared in response to the Administration Center's request for technical assistance in formulating their recommendations.

OBJECTIVES OF THIS PAPER

1. Evaluate the usefulness of readability formulas and other methods for achieving Army readability objectives.

2. Determine the method which most effectively assures achievement of Army readability objectives.

THE ARMY'S PROBLEM

The Army's objective is to produce publications which all of its reader population can use effectively. To achieve this objective publications must satisfy two interrelated conditions. They must: (a) clearly address the job and training needs of the target audience, and (b) be written in a style that is easily comprehended by soldiers in the target audience. The Army has made considerable progress in applying Instructional Systems Development (ISD) as a tool to identify content oriented to the job and training needs of a target audience. Present need is for a method to use in monitoring and improving the production of written materials to assure that readers in the target audience will be able to comprehend them. Of particular concern are the below average to average readers. This concern is reflected in the reading difficulty level standards specified in the recent Department of the Army Circular 310-9 (Improving the Readability of Army Publications). For example, these standards set a target reading difficulty level of the 7th grade for training and job publications prepared for soldiers in pay grades E-1 through E-4. Data recently reported by Mathews, Valentine and Sellman suggest that as many as 30 percent of the soldiers entering the Army score below the 7th Reading Grade Level (RGL) on a Gates-MacGinitie

Reading Test (Mathews et al., 1978). These data suggest good reason for the Army's concern over providing job and training publications that can be used effectively by the below average reader. The question is, can readability formulas provide a sound basis for achieving the Army's readability objectives? Are there alternative approaches that will be more effective?

WHAT DOES A READABILITY FORMULA PREDICT?

Readability formulas provide a method for rank ordering difficulty level of textual materials in relation to average comprehension test performance of students at successive school grade levels. These rank order scores are usually expressed as reading grade levels (RGL). School grade levels provide a means of indexing general growth in language skills displayed by the average student over the course of their exposure to school and their culture. A great deal of their appeal rests on the assumption that if a relatively difficult passage can be pegged, say, at the 12th school grade level, then the user knows how "high" that is compared to one pegged to some lower grade level, say, the 5th grade level. To accomplish this "pegging," readability formulas are developed to predict the school grade level at which students, if given a comprehension test on the passage in question, will achieve an average test score equal to some pre-set criterion, for example, 70 percent correct. For instance, a 10th grade level readability score represents a prediction that approximately 50 percent of the 10th grade students will be able to read the passage and pass a comprehension test given immediately after the reading. If this prediction could be made with complete accuracy we would expect less than 50 percent of the 9th grade students and more than 50 percent of the 11th grade students to pass the comprehension test. Obviously these predictions cannot be made with complete accuracy. So the question is how much error can be expected in these predictions? What are the implications of the amount of error and sources of error for the way the Army proposes to set standards and use these formulas?

USEFULNESS OF READABILITY FORMULAS FOR ACHIEVING ARMY OBJECTIVES

Usefulness of readability formulas for achieving Army objectives hinges on three major considerations: (a) How effectively do formulas predict comprehension at targeted reading grade levels? (b) Does rewriting to lower readability scores result in increased comprehension? And, (c) How will formula score requirements affect production of written materials?

How Effectively Do Formulas Predict Comprehension At Targeted Reading Skill Levels?

Data contained in two recent studies permit a look at how well readability formulas predict the grade level criteria used in the development of the formulas (Caylor et al., 1973; Kincaid et al., 1975).

Both of these studies were concerned with development of readability formulas for military personnel using military job and training materials. Caylor et al. developed the FORCAST formula using Army recruits and passages from Army job and training publications. Kincaid et al. recalculated six readability formulas using Navy enlisted personnel with service of six months or less and passages selected from Navy job and training material.

Comprehension Criteria Expressed As Grade Levels. Caylor and Kincaid used the same method for establishing the grade level-comprehension criteria to be predicted. This method consisted of first administering a standardized reading test[1] to the people in the sample to identify their reading grade level placement. The experimental passages were then given in the form of cloze tests.[2] Grade level comprehension criteria were then determined by identifying for each passage the lowest reading grade level in which 50 percent of the men reading at that grade level achieved a cloze score at or above the 35 percent correct criterion level.[3] The resulting criterion reading grade levels, called scaled Reading Grade Levels (RGL), are shown in Table 1 for the 18 passages used by Kincaid and in Table 2 for the 12 passages used in developing the FORCAST. The formulas were then developed, using multiple correlational techniques, to predict the scaled RGL value for each passage. The FORCAST formula uses number of one-syllable words in a 150 word passage as its predictor. The recalculated Flesch formula uses average number of syllables per word and average number of words per sentence to predict the scaled RGL.

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[1]Different standardized reading tests were used in the two studies. Caylor et al. used the United States Armed Forces Institute (USAFI) Achievement Tests III, Abbreviated Edition, Form A (a special printing of the Metropolitan Achievement Test, Advanced Battery). Reading Grade Level scores on this test can range from 1.3 to 12.9. Kincaid et al. used two forms of the Gates-MacGinitie Reading Test. Form E (grade levels 7-9) was given to personnel with GCT scores below 55. Form F (grade levels 10-12) was given to those with GCT scores of 55 and above.

[2]Cloze tests systematically omit words which testees are asked to fill in as a measure of comprehension. Caylor et al. used five cloze tests for each of their 12 passages. Version 1 deleted every fifth word counting from the first word in the passage. Version 2 deleted every fifth word counting from the second word in the passage and so forth. Kincaid et al. apparently used only one version for each passage.

[3]Based on earlier research 35 percent correct on a cloze test is assumed to be equivalent to 70 percent correct on a multiple choice comprehension test.

TABLE 1

Comparison of Scaled Reading Grade Level (RGL) Values with Recalculated Formula Scores for the Eighteen Passages used by Kincaid et al., 1975.

		Recalculated Formulas				
Passage Number	Scaled RGL	Kincaid-Flesch	FORCAST (Rev.)	ARI (Rev.)	FOG Count (Rev.)	Gunning FOG (Rev.)
15	5.5	8.4	7.9	7.7	10.1	9.2
17	5.8	9.3	11.8	10.2	9.9	11.0
1	6.9	9.7	8.0	8.5	10.9	7.7
5	7.0	7.1	9.7	8.6	7.5	6.9
9	7.8	8.0	8.1	8.0	8.9	5.9
10	8.9	11.7	10.5	11.9	12.9	12.0
13	8.9	10.0	9.0	11.5	11.0	8.5
11	9.0	8.1	10.6	7.0	6.5	7.3
18	9.8	6.6	8.0	10.6	6.7	7.4
14	10.8	12.5	12.1	10.6	12.2	12.0
4	10.9	8.2	9.5	7.9	7.3	7.5
16	11.8	13.8	13.9	12.7	12.5	15.4
7	12.0	11.7	11.8	11.3	11.6	10.6
3	16.0	12.7	13.0	12.4	11.4	12.7
6	16.0	12.3	13.8	11.3	11.2	10.8
2	16.1	16.7	15.6	18.3	14.4	12.1
12	16.1	11.8	8.7	12.6	13.5	9.7
8	16.3	14.7	13.5	14.7	16.4	14.9

Note: Scaled RGL and Recalculated formula values for the Flesch, Automated Readability Index (ARI) and the FOG count are from Table 2, Kincaid et al., 1975. Values for the Recalculated Gunning FOG Index and revised FORCAST were calculated by John Brand, US Army Administration Center (USAADMINCEN) and the author based on data provided by Kincaid.

TABLE 2

Comparison of Scaled Reading Grade Level (RGL) Values with Form 1a Scores for the Twelve Passages used in the Development of the FORCAST Formula by Caylor et al., 1973.

Passage Number	Scaled RGL	Formula RGL Values FORCAST (Original)	Dale-Chall	F-J-P Flesch[a]
21	6	8.6	7-8	7
12	7	7.8	7-8	6
11	7	7.6	5-6	5
13	7.3	9.4	7-8	8-9
23	9.1	10.1	11-12	13-16
22	9.6	10.7	9-10	10-12
15	11.4	12.1	13-15	13-16
16	11.8	13.2	16+	16+
26	12.0	12.2	16+	16+
25	12.0	13.2	16+	16+
24	12.1	11.3	13-15	13-16
14	13.0	10.9	13-15	13-16

Note: All values were taken from Caylor et al., 1973.

[a]F-J-P Flesch is the Farr-Jenkins-Paterson revision of the Flesch Reading Ease formula.

Comparison of Predicted RGL With Scaled RGL Criteria. Tables 1 and 2 compare the scaled RGL values for the passages in each study with the RGL score obtained by applying the formula to the passage. The purpose of these comparisons is to illustrate the fact that present readability formulas do not predict comprehensibility of material for specific reading grade skill levels. They simply do not possess that precision. In fact, inspection of the comparisons shown in Table 1 for the Kincaid-Flesch suggests that the precision of this formula is limited to predicting whether comprehensibility of the material (Scaled RGL) is above or below about the tenth RGL.

Range Of Formula Scores For Scaled RGL Intervals. Lack of precision in these predictions is illustrated by comparing the range of scores obtained from a given formula with the scaled RGL scores for the same passages. The scaled RGL criteria and formula scores for the passages are shown in Table 3 for the Kincaid-Flesch. Suppose that the Army wanted material that could be readily understood by soldiers reading at the 5th to 6th RGL. The first row in Table 3 shows that the passages that met grade level comprehension criteria at the 5th to 6th RGL could have Kincaid-Flesch scores ranging from the 8th to the 9th grade level. Likewise soldiers whose reading skills were at the 7th to 8th grade level could receive material ranging in Kincaid-Flesch scores from the 7th to the 11th RGL. The range of Kincaid-Flesch scores for passages that required reading skills at the 9th to 10th grade level is even broader, ranging from the 6th to the 12th grade readability score. The right hand column of Table 3 shows corresponding data used in developing the FORCAST formula. It should be pointed out that the lack of precision in predicting specific reading grade skill levels just illustrated is not specific to the Kincaid-Flesch. A similar lack of precision is characteristic of all of the formulas in Tables 1 and 2.

Range Of Formula Scores When Applied To New Passages. What happens when formulas are applied to new passages not used in developing the formula? Tables presented above have illustrated the lack of precision in predicting grade level comprehension criteria for passages used in developing the formulas. These are the conditions when the formula should give its most accurate prediction. We would expect more error in prediction when the formula is applied to new passages. The author calculated the FORCAST scores for the 18 passages Kincaid et al. used in their study. Kincaid-Flesch scores were also calculated for the 12 passages used in the development of the FORCAST formula. Table 4 compares the results obtained when each formula was applied to its own developmental passages with the results obtained when each formula is applied to the other formula's developmental passages. The last column in Table 4 for each formula represents an estimate, based on these available data, of the range in formula scores we might expect for material meeting comprehension criteria at each of the scaled grade level intervals. These data should severely shake the confidence of those advocating production standards that will match RGL of materials with RGL of readers.

TABLE 3

Comparison of Scaled Reading Grade Level (RGL) Values with Range of Formula Values Obtained on Passages used in Development of the Kincaid-Flesch and FORCAST Formulas.

Scaled RGL Interval	Kincaid-Flesch Kincaid Passages	FORCAST FORCAST Passages
5-6	8-9	8
7-8	7-11	7-9
9-10	6-12	10
11-12	11-13	11-13
13+	11-16	10

TABLE 4

Range of Formula Values Obtained by Applying Kincaid-Flesch and FORCAST Formulas to Passages used in Development of Formulas and New Passages.

Kincaid-Flesch Formula

Scaled RGL Interval	Kincaid Passages	New (FORCAST) Passages	Composite Estimate of Range
5-6	8-9	5	5-9
7-8	7-11	3-6	3-11
9-10	6-12	7-12	6-12
11-12	11-13	14-21	11-21
13+	11-16	11	11-16

FORCAST Formula

Scaled RGL Interval	FORCAST Passages	New (Kincaid) Passages	Composite Estimate of Range
5-6	8	9-11	8-11
7-8	7-9	9-10	7-10
9-10	10	9-11	9-11
11-12	11-13	11-12	11-13
13+	10	10-13	10-13

Conclusion: Formulas Cannot Match Material To Reader. Readability formulas do not provide reliable predictions of reading skill levels (RGL) at which material can be adequately comprehended. This conclusion is not restricted to the Kincaid-Flesch and the FORCAST. All of the readability formulas shown in Tables 1 and 2 have high rank order agreement with each other.

Does Rewriting To Lower Readability Scores Result In Increased Comprehension?

The wide range of error possible in using a readability score to predict whether or not material will be appropriate for soldiers at the lower reading skill levels was illustrated above in Tables 1-4. These tables demonstrate quite clearly that present day readability formulas can not be used to match difficulty level of the material to reading skill levels of below average readers.

People concerned with producing understandable reading material for below average adult readers advance a second argument for use of readability standards. This argument is that lowering the readability levels of the material will result in higher levels of comprehension by the below average reader. This apparently is the assumption on which readability standards in Department of the Army Circular 310-9 are based.

Klare's Review of Research Literature. Klare reviewed 36 experimental studies performed to study the effects of lowering or raising the readability score level of passages on comprehension of the material (Klare, 1976). The general approach in this type of research is to rewrite a given passage to make it easier (or harder) than the original passage without changing content meaning. "Easier" or "harder" is determined by applying a readability formula. The easier and harder versions of the same passage are then given to different groups of readers and comprehension scores are obtained and compared. Klare concluded that differences in comprehension were obtained in 19 of the 36 studies, no differences were found in 11 studies, and the remaining 6 studies produced "mixed" results. The importance of Klare's review to the present concern is that it suggests that present day optimism that simply reducing reading difficulty level of material will increase the reader's comprehension stands on shaky ground. Recent research examining this same question has been carried out by the Navy and by the Air Force.

Recent Air Force Research On Lowering Readability Level Of Text. The Air Force studied basic trainees at two reading test skill levels, 8th and 10th Reading Grade Level (Kniffin et al., 1979). The purpose of this research was to measure the effects upon reading comprehension of three sizes of literacy gap, zero gap (readability score numerically equal to tested RGL), -2 gap (readability score 2 RGL higher than tested RGL), and -4 gap (readability score 4 RGL higher than tested RGL). Four versions of two different passages selected from Air Force training

TABLE 5

Average Comprehension Scores (Percent Correct) Obtained by Reading Skill Levels at each Reading Difficulty Level Version of Two Passages (Kniffin et al, 1979).

Reading Grade Level of Airmen		Reading Difficulty Level of Material 8th GL	10th GL	12th GL	14th GL
10th RGL	Passage 1	X	67	64	62
	Passage 2	X	81	78	79
8th RGL	Passage 1	58	61	56	X
	Passage 2	82	76	73	X

materials were prepared. The 10th reading grade level subjects received versions of the two passages written at the 10th, 12th, and 14th grade readability level (Kincaid-Flesch formula). The 8th reading grade level subjects received versions written at the 8th, 10th and 12th grade readability levels. The same 52-item multiple-choice comprehension test for each passage was used with all subjects. The authors conclude that the literacy gap produced a statistically significant but small effect upon comprehension scores.

Table 5 presents the average comprehension scores (percent correct) obtained by each group in the Air Force study. These scores illustrate again the inadequacy of readability formulas for predicting grade level comprehension criteria. Note that readers at the 8th grade level do not reach the predicted 70 percent comprehension score for passage 1 on the version written at the 8th grade difficulty level. In addition they appear to do almost as well on the 12th grade version of passage 1 as they did on the 8th grade version. Also note the differences in comprehension scores for passages 1 and 2 at the same reader skill level when the two passages each received the same readability score. Passage 2 is consistently easier.

Recent Navy Research On Lowering Readability Of Text. A report on the Navy's research is not yet available. However, major features of the research plan and main conclusions were given in an oral presentation by Duffy (Duffy, 1979). Navy research studied the effects of careful rewriting "to formula" on comprehension at different reading skill levels.

Navy researchers took the eight passages used in the Nelson-Denny Reading Test and, treating them as a set, prepared three different versions of the set. One version was prepared by changing only vocabulary. Shorter word synonyms taken from standard 4th grade vocabulary lists were substituted for approximately 25 percent of the passage words. This resulted in lowering the average Kincaid-Flesch score from 11.5 to 10.1 Reading Grade Level (RGL). A second version was prepared by only shortening sentences. This resulted in an average Kincaid-Flesch score of 7.3 RGL. A third version involved both vocabulary and sentence changes and dropped the average Kincaid-Flesch score to 5.5 RGL.

The Navy conducted four different studies with the original and the three revised versions of these passages. In each study the four versions were presented to sailors at high (10.5 and above), middle (8.5 to 10.5) and low (7 to 8.5) RGL. In Study 1 the standard Nelson-Denny time limits were imposed and questions and text were presented together as in the usual reading test procedure. Easier versions did not produce improved comprehension at any of the three reading skill levels. In Study 2 time limits were removed and questions were previewed prior to seeing the text. After reading, the text was removed and the questions were again presented. Results were the same as in the first study, easier

versions did not produce improved comprehension. In Study 3 the passages were presented in the form of cloze tests with no time limits. Again, easier versions did not produce improved comprehension. And finally, testing conditions in Study 4 paralleled the "reading to learn" conditions of a classroom setting. Sailors were allowed to study the passages with no time limits imposed. Passages were then taken away and the test was administered. Once again easier passages did not produce improved comprehension for the high and mid-level reading skill groups. The low reading skill group (7 to 8.5 RGL) did show an increase in comprehension. However, the greatest increase (38 percent on original version vs 53 percent) was on the set of passages which had an average readability score at the 10th grade level and was the most difficult of the easier versions.

Conclusion: Rewriting To Lower The Formula Score Does Not Increase Comprehension. Civilian and military research reviewed above suggests that lowering difficulty of text by rewriting to formula does not enable readers to comprehend material they could not comprehend from the more difficult version.

How Will Formula Score Requirements Affect Production Of Written Material?

The Army's major purpose in establishing Reading Grade Level (RGL) standards for material is to insure a closer match between difficulty level of the material and reading skill level of the intended readers. It has been assumed that the RGL scores obtained from readability formulas identify the reading skill level (also expressed in RGLs) at which readers will adequately comprehend the material. Research reviewed above clearly indicates that this is a false assumption. Readability formulas do not possess the predictive power to identify reading skill levels at which specific material will be adequately comprehended. Data reviewed suggests that their predictive power is limited to predicting that material written above the 10th RGL will generally be too difficult for soldiers whose reading skills fall below the 10th RGL. Other research reviewed above indicates that rewriting "difficult" text to "easier" readability score levels has no practical effect on improving readers' comprehension of the text. Thus, use of readability formula scores to determine when reading skill level standards have been met and when material must be rewritten to satisfy the standards will be ineffective in achieving Army objectives.

In addition to being inaccurate, use of formula scores to identify readability standards has other serious drawbacks. Formulas do not require the writer and editor to examine the writing for clarity in addressing the targeted readers' information needs. When imposed as a standard that must be met, attention tends to be focused on meeting the score requirement rather than on organizing the material to meet the readers' information needs.

Accommodations made to enable writers to meet formula standards may even promote the production of less readable writing. For example, the writer is often caught in the crunch of preparing material in a job area that has a large, well established technical vocabulary. These are usually multi-syllable words. It is generally considered mandatory that the writer use these words. The Army Materiel Command (now Army Materiel Development & Readiness Command) estimated in 1970 that approximately one-third of the words used in their technical manuals were mandatory words (Army Materiel Command, 1970). This proportion of multi-syllable words alone would result in a FORCAST estimate of reading difficulty at the 10th grade level. This poses a problem for the writer who must use these words yet still stay within formula score requirements. A common solution to this probelm is to keep the same formula score requirement but adjust either the formula or the method of counting. The effect of these adjustments is to pretend the technical terms aren't there for purposes of computing the score. This solution is justified by the argument that technical words either are or will quickly become familiar words to everyone, from entry level on up, working in the technical area. Apparently, efforts to verify this assumption are rarely made. Those that have been reported fail to support it (Jablonski, 1971; Hooke et al., 1979).

Common acceptance of the assumption that technical terms are well known terms illustrates how the push to meet formula score standards can actually promote production of less readable writing. Given this assumption of word familiarity, writers do not have to focus their attention on how to best communicate technical information to readers who have limited understanding of the technical area and its jargon.

The Air Force recently completed a research study of the effectiveness of their readability standards in improving comprehensibility of publications in seven career fields. A major implication for the Air Force cited in this study is as follows:

> The policy of writing to target audience should be continued but should not be enforced rigidly. Given the relatively crude ways employed at present to estimate literacy gap, it is probably not appropriate to insist that writers hit their targets with a great deal of precision. Additionally, the practical problems involved in simplifying materials below tenth grade level may be insurmountable (Hooke et al., 1979).

Conclusion: Requiring that text be written to satisfy a targeted reading grade level score shifts attention to meeting the score requirement rather than focusing attention on organizing material to meet the readers' information needs.

A MORE EFFECTIVE APPROACH TO ARMY OBJECTIVES

The recent focus on readability formulas has diverted attention from developing and improving other approaches to readability standards. As stated at the beginning of this paper, to achieve Army readability objectives, publications must satisfy two interrelated conditions. They must: (a) clearly address the job and training needs of the target audience, and (b) be written in a style that is easily comprehended by soldiers in the target audience. A readability formula provides no information on how well writing meets the job and training needs of the target audience. Formula scores provide only a gross index to how well the writer has achieved an easily comprehended style. As numerous supporters and critics of readability formulas have pointed out the writing could be completely nonsensical and still obtain an "easily readable" formula score. Thus, readability formulas can serve at best, only a minor role in achieving Army objectives for improved readability of publications. Achievement of Army objectives requires use of a broader-based method for establishing readability standards and for evaluating written material against these standards.

A broader-based method, appropriate for the Army's use, does not exist and will have to be developed. However, general models for such a method and many of the components that would be used in developing the method do exist. The basic model is the checklist used by editors and teachers of technical writing to identify major features of a manuscript which, by their judgment, are important contributors to its final readability. Content and level of detail in existing checklists depends on the developer's special interests. Checklists in technical writing texts tend to focus on general principles of content organization rather than specific types of material. The usual editor's checklist tends to focus primarily on form (grammar, punctuation, spelling and format) rather than on function (organization to convey information, depth and scope of coverage, and so forth). Checklists developed to accompany Military Specifications become extremely long and detailed. Figures 1 and 2 present the table of contents for a checklist prepared for use by the Navy in conducting quality assurance (Price, 1975). Figure 3 shows the major headings of a much shorter checklist developed by Air Force researchers to rate quality of manuals based on the presence or absence of problems users in the field encountered in trying to use the manuals (Ross, 1959). None of these checklists are directly appropriate for present Army objectives. The point is that checklists can be designed to identify major types of problems judged to make reader comprehension of the message more difficult. They can be tailored to the special kinds of problems Army writers encounter in communicating different kinds of material (for example, administrative regulations versus job training materials). Their effectiveness can even be submitted to experimental validation. And finally, they can provide more useful diagnostic guidance to the writer on how to go about a rewrite than is provided by readability formulas.

		Page
1.	ORGANIZATION	I- 1
	A. Principal Units and Work Packages	I- 1
	B. Arrangement within Sections or Packages	I- 1
	C. Composition Practices	I- 2
	D. Prose-Graphic Balance	I- 3
2.	PROSE COMPREHENSION	I- 5
	A. General Style Principles	I- 5
	B. Instructional Writing	I- 6
	C. Paragraphs	I- 7
	D. Sentences	I- 7
	E. Words	I- 8
	F. Non-Text Words and Phrases	I-10
	G. Legibility	I-11
3.	GRAPHICS COMPREHENSION	I-12
	A. General Graphics Principles	I-12
	B. Graphic Form Selection	I-14
	C. Schematic and Wiring Diagram Practices	I-15
	D. Network Diagram Practices	I-16
	E. Block Diagram Practices	I-17
	F. Illustrations Practices	I-17
	G. Freestanding or Series Pictorials	I-18
	H. Tables Practices	I-18
	I. Graphs Practices	I-20
	J. Photograph Practices	I-20
4.	READABILITY MEASUREMENT	I-21

Figure 1. Major Headings From:
IN-PROCESS REVIEW CHECKLIST
PART 1 - PRESENTATION QUALITY
(Price, 1975)

Page

1. ACCESS AND SEARCH II-1
   A. Identification II-1
   B. Sections or Packages II-1
   C. Table of Contents and Headings II-2
   D. Index II-2
   E. Reference Compliance II-3

2. USABILITY AND ACCEPTANCE II-5
   A. Information Content Adequacy II-5
   B. Job Relevance and Efficiency II-7
   C. Workplace and User Compatibility II-7
   D. Technical Scope and Accuracy II-8

Figure 2. Major Headings From:
IN-PROCESS REVIEW CHECKLISTS - PART II
-JOB PERFORMANCE ADEQUACY
(Price, 1975)

I. Layout
   A. Physical Characteristics of the Manual
   B. Order in Individual Operations
   C. Index, Glossary, Charts, and Forms

II. Readability and Comprehensibility
   A. Readability
   B. Comprehensibility

III. Decision Making Procedures
   A. Preparation of Decision Making Procedures
   B. Trouble Indicators

IV. Diagrams, Photographs and Drawings
   A. Diagrams
   B. Photographs
   C. Drawings

Figure 3. Major Headings From:
CHECKLIST FOR EVALUATION OF TECHNICAL MANUALS
(Ross, 1959)

Development of an Army Readability Standards Checklist requires a research and development effort. This checklist should be developed to meet the following objectives: (a) identifies specific problems that need to be corrected when standards are not met; (b) is not limited to only connected prose but is applicable to the entire manuscript (for example, illustrations, tables and index); and, (c) does not require extensive technical editing and writing expertise to apply. Extent of this effort will depend on the final objectives established for the checklist. Initial development will focus on working with Army writers and editors to identify content for the different major types of literature produced. Draft checklists will be tried out by writers and editors at different levels in the production chain. Two major criteria will be employed during this developmental process: (a) extent of agreement among writers and editors in making specific judgments on the same material, and (b) relationship of these judgments to users' judgments of comprehensibility of the material.

Development of the type of checklist described above will require analyses of the different types of material currently being produced. An example of this type of analysis and the kinds of problems writers and editors might expect to find is provided by research conducted for Army Research Institute (ARI). This research was initiated in the early 1970's in response to the Army's concern over the high reading difficulty levels of training and job materials entry level enlisted personnel were expected to use. Part of this research involved performing an extensive analysis of the contents of Army Field Manuals and Technical Manuals. This analysis resulted in the identification of a number of writing problems, summarized under seven major problem areas (Kern et al., 1977):

(a) Hard words, long sentences.

(b) Topic oriented writing - not directed to any particular job user.

(c) Main points lost in detail - too vague, too wordy.

(d) Confused development - main points fragmented across paragraphs.

(e) Remote references - text relies on material located elsewhere.

(f) Weak visual aids - absent, illegible, not related to text.

(g) Run together format - lengthy, solid masses of print.

Pages from Field Manuals (FMs) and Technical Manuals (TMs) were selected to illustrate these problems. The final sample of pages reflected technical, combat and administrative content produced by writers from 11 different Army schools. Each sample was rewritten to provide a clearer, less difficult version of the material. The rewriting, performed by research staff members, focused on the seven problem areas listed above. Note that only one of the seven problem areas listed, the first one, can be addressed by writing to a readability formula. Preparation of clearer, less difficult versions of the pages sampled from FMs and TMs required extensive structuring and reorganization of the way the information was presented. These changes are illustrated visually by the "Before" and "After" examples presented in the Guidebook (Kern et al., 1977).

As demonstrated earlier, writing to a formula does not improve readers comprehension of the material. The criterion for readability should be one that writers and editors could be encouraged to use as a guide to improve their writing. Research conducted in 1974 for ARI indicated that most Army writers are instructors who have not had formal training in technical writing (Appendix). Editors tended to confine their review of manuscripts to punctuation, spelling and format regulations. A checklist which identifies common problems in organizing and presenting information to meet the readers needs could also assist the editors in performing their job more effectively.

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APPENDIX

The Study of Writing in Functional Contexts: The Army Writer and the Design of a Guidebook for Developing Army Training Literature

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Human Resources Research Organization (HumRRO)

March 1974

Prepared For:

U. S. Army Research Institute
Contract: S73-33 (ATL), DAHC19-73-C-0051

This is a special report designed for management on information developed in HumRRO Work Unit ATL (Army Training Literature), Tasks 4, 5, and 6 (Development of a Guidebook for Writers of Army Training Literature). The report summarizes interviews with Army writers. It presents the implications of this information for the design of the guidebook and for policy regarding Army training literature development.

GUIDEBOOK FOR THE DEVELOPMENT OF ARMY TRAINING LITERATURE:
RATIONALE AND POLICY IMPLICATIONS FROM INTERVIEWS WITH ARMY WRITERS

Contract: S73-33 (ATL)
DAHC19-73-C-0051

PROJECT REQUIREMENTS: To design a Guidebook for Army writers which will actually be used, information is needed about the Army writer and his job.

PROCEDURE: Conduct interviews with Army writers to find out who they are, how they do their jobs, and what they think a writer's guidebook should include to be of help to them.

INTERVIEW POPULATION: Army writers and editors located at five Army Service School Centers chosen to reflect agencies responsible for producing literature supporting relatively high density Military Occupational Specialty (MOS) areas.

School	MOS Area	No. Interviewed
Infantry School, Fort Benning	Combat	19
U.S. Army Signal Center and School, Fort Monmouth	Technical	24
U.S. Army Ordnance Center and School, Aberdeen Proving Ground	Technical	25
U.S. Army Quartermaster School, Fort Lee	Technical	9
U.S. Army Institute of Administration, Fort Benjamin Harrison	Administrative	17
	Total	94

MAJOR CONCERNS:

I. The Army Writer
- Who are Army writers?
- What are their qualifications?
- How is their time distributed over writing and instruction?

II. Use of Writers' Guidebooks
- Do writers use guidebooks?
- What information would writers find useful in a guidebook?

III. The Current Writing Process
- What information is the writer given in a writing assignment?
- What types of support does the writer have during the writing process?
- What type of quality control is used prior to publication?
- How is feedback obtained from users?

IV. Nature of Army Training Literature (ATL)
- How are Army Training needs identified?
- Is ATL topic or job performance oriented?
- Are training and reference functions of ATL distinguished?

CONCERN 1: THE ARMY WRITER

QUESTIONS: WHO ARE ARMY WRITERS?
WHAT ARE THEIR QUALIFICATIONS?

SUMMARY OF INTERVIEWS

Writers of Army-Wide Literature are usually personnel who are considered subject matter experts in the assigned writing area, and who are instructors in the area. At the Infantry School, writers were predominantly military officers. At the technical and administrative schools writers were predominantly civilian personnel and either present or former instructors. Qualifications for military and civilian writers were usually stated as: (a) subject matter experts; (b) experienced as instructors; (c) demonstrated ability to write instructional materials. Most writers were college graduates with no formal training in technical writing.

QUESTION: HOW IS THEIR TIME DISTRIBUTED OVER WRITING AND INSTRUCTION?

The writing assignment is an extra duty for most writers who must also instruct. Writers pointed out that in the school setting, first priority is given to instruction and the operational requirements associated with supporting instruction. Writing manuals is a low priority effort given little support. The instructor-writer felt conflicts between the time required to perform his instructional duties and the time required to research and write an adequate manual, with manual writing suffering from lack of time. Among military writers a high rate of turnover exists, with writing assignments being passed on from man-to-man.

IMPLICATIONS

For The Guidebook: The part-time nature of the writing job suggests that the Guidebook must be designed to be used by people who cannot and will not devote considerable time to study to learn to be better writers. Hence the Guidebook should avoid trying to train writers, and instead minimize the amount of "mental energy" the writers must expend to use the Guidebook. As much as possible the attempt should be to:

* Catalog information in the Guidebook, not in the writer's head.
* Provide aids for decision making and accomplishing recurring procedures.
* Emphasize intuitive understanding by examples rather than lectures on "how to do it."

For Army Policy: The critical position of Army Training Literature writers needs considerably more identity and stability if writers are to effectively produce and also develop skills and techniques to meet the changing needs of the Army. The Army should consider creating permanent, full-time technical writers slots for the production of Army Wide training manuals. Then it would not be unreasonable to expect these personnel to undergo formal training in effective writing and to continue to update their knowledge of ways to use printed communication to support training and job performance.

CONCERN II: USE OF WRITERS' GUIDEBOOKS

QUESTIONS: DO WRITERS USE GUIDEBOOKS?
WHAT INFORMATION WOULD WRITERS FIND USEFUL IN A GUIDEBOOK?

SUMMARY OF INTERVIEWS

Most of the writers interviewed said they do not use writer's guides of any type. They get the guidance they need regarding format and organization by reviewing previous editions of the same manual or a related manual. Some writers, however, felt the following additional types of guidance would be helpful:

a. identify reference sources for literature research
b. how to conduct literature research
c. outline steps necessary for writing, going from inception to final review
d. how to develop outlines
e. how to organize material to facilitate learning
f. how to determine reading grade level of material
g. how to write at predetermined grade level
h. when is it appropriate to be redundant?
i. when is it important to summarize?
j. guidance in types and best use of illustrations
k. how to obtain copyright release
l. guidance in determining user, purpose, and scope

CONCERN III: THE CURRENT WRITING PROCESS

QUESTION: WHAT INFORMATION IS A WRITER GIVEN IN A WRITING ASSIGNMENT?

Writers appear to be provided with little or no guidance regarding users, purpose or scope when a new manual is to be written. Because the writer is a subject matter expert, he is expected to define these objectives. Lack of consistency in identifying users, purpose and scope was evidenced. Users, when identified, are usually identified in terms of the organization (e.g., Company or Battalion) or the Army at large (e.g., everyone from Private to General) and rarely in terms of specific job positions within any organization. For revisions, writers generally never see files containing the previous manuscript, review comments, and change recommendations that have come in since its publication.

IMPLICATIONS

For The Guidebook: Many writer's guides are available in the Army today which provide extensive discussions of many of the topics mentioned by writers as candidates for a writer's guide, yet writers do not use these guides. As suggested above, the ATL Guidebook should try to capitalize on the fact that writers get ideas about format and organization by reviewing a previous edition of a manual or related manuals. Thus, the ATL Guidebook should provide a "sampler" of various formats in different content areas which writers can get ideas from for use in their manuals. Guidance should be given for identifying users, for determining writing objectives, and for selecting, assembling and organizing content.

For Army Policy: A concerted effort should be made to make current Army writer's guides available to all writers. Continued education of the writers regarding the contents of various guides is needed. This goes hand-in-hand with the recognition of the writing job as a professional position within the ATL system.

For Army Policy: The writer's writing assignment should specify the purpose of the manual, the intended major user, the subject area, and what duties and tasks the writer is expected to relate the subject area to. For revisions, the writer should also be given a file containing all comments and change recommendations that have come in since the last publication of the manual.

CONCERN III: (CONT.)

QUESTIONS: WHAT TYPES OF SUPPORT DOES THE WRITER HAVE DURING THE WRITING PROCESS?
WHAT TYPE OF QUALITY CONTROL IS USED PRIOR TO PUBLICATIONS.

SUMMARY OF INTERVIEWS

To research information writers rely heavily on school lesson plan files and previous editions of the manual. Whenever possible they "cut-and-paste" from the earlier manuals as well as from current editions of related manuals. They generally are dependent upon the routine Post training aid support for illustrators; contact with the illustrator tends to be of a paper-work, through channels nature and not face-to-face communication. This, plus the experience of long time delays cause most writers to avoid any use of illustrations beyond their own capabilities or beyond those that can be cut-and-pasted from other manuals. Writers did not use readability formulas or other methods for testing the difficulty of their writing. Editorial review of the writer's draft is generally limited to grammar, proof reading and conformance to format policies. There is apparently no review by the writer or editor of copy set-up by the printer prior to production printing.

QUESTION: HOW IS FEEDBACK OBTAINED FROM USERS?

Generally, the only feedback writers receive from users is from the students in the classroom. Field reviews were considered ineffective formalities. Suspense dates for review were considered too immediate to allow adequate review. Writers who had served as reviewers stated that once their written comments were provided, they learned nothing of the acceptance or rejection of their comments. Instructors also considered the filling out of recommended change forms (Form 2028) as futile because they saw the same errors repeated in future revisions. Generally, writers reported they had never seen Field Review comments on manuals they had written and had no idea whose comments had even been solicited.

IMPLICATIONS

For The Guidebook: Writers need information about the users of their products. The Guidebook should give guidance in:

* identifying primary and other users
* determining reading abilities of users

The guidebook should give guidance in using information about users to:

* define purpose and scope of manuals in terms of users
* write at the reading levels of the primary users

The guidebook should acknowledge the writer's tendency to imitate past work, especially under time pressures, and provide a ready source of a large set of samples of bad and good writing, formatting, and illustrating which writers could examine and imitate the good samples. Guidance should be provided for the use of the FORCAST readability formula developed for use with Army manuals as a quality-control tool during writing and review of drafts.

For Army Policy: Again, the part-time nature of the writing position places undue pressures on time. Higher priority to the writing of ATL, including a better defined and more permanent position, would appear desirable. Research reference files should be maintained and made available to the writers rather than being an individual writer's responsibility. These files should also include available task analyses information on the various users to whom manuals may be addressed. Provisions should be made for more direct illustrator support with the illustrator a member of the writing staff. Quality control during writing and processing of the draft should be reviewed for approaches to improving it.

For The Guidebook: Since the only feedback writers receive is from students in the classroom setting, the Guidebook should stress the use of formal or informal task analysis information to help the writer in addressing their manuals to user's needs in the field. Contacts limited to school students also mean that writers have little or no contact with users in the field who are less capable readers than they or their students. Therefore, the Guidebook should help the writer understand the nature of the problems the poorer reader faces in extracting information from printed materials.

For Army Policy: The current system does not provide feedback that writers or literature planners can use to tell whether a manual, once produced, meets the needs of the intended user, or, in fact, is even used. The Army should consider a new system to either supplement or replace the Field Review process. The new system should be a regular system managed by a central authority (e.g., TRADOC). It might, for example, collect information from users in the field on the utility and acceptability (readability and readership) of training literature publications and feed this information back to the training literature branch which prepared the publications. If this information were collected at the direct user level and not just at the field command level it should provide useful guidance for both the planning and writing of ATL.

CONCERN IV: NATURE OF ARMY TRAINING LITERATURE

QUESTION: HOW ARE ARMY TRAINING LITERATURE NEEDS IDENTIFIED?

SUMMARY OF INTERVIEWS

Under the present system school staff carry a major responsibility for identifying Army Wide literature needs. Each school periodically reviews the Field Manuals, Technical Manuals, etc., for which they are responsible. From this review recommendations are made for updating or preparing new material. The school consolidates these recommendations, including any comments received from the field, and staffs them through TRADOC for approval, budgeting and priorities. Manuals are then assigned to the appropriate branch or instructional department, where specific manuals are, in turn, assigned to the person who will do the actual writing. When the assignment reaches the writer it is frequently simply a directive to write a manual on "subject X".

QUESTIONS: IS ATL TOPIC OR JOB PERFORMANCE ORIENTED?
ARE TRAINING AND REFERENCE FUNCTIONS OF ATL DISTINGUISHED?

Writers view their jobs as that of assembling, organizing and recording what is known about a topic. It is assumed that if a manual contains a reasonably complete exposition of the topic, it can serve as a general text or reference source and be used by anyone for any purpose, whether initial learning, looking-up previously learned information, or consulting for directing the training, learning and job performance of others. Manuals were only rarely considered in terms of job duties or task performance.

IMPLICATIONS

For Army Policy: A clear identification of the purpose and intended major user of ATL would seem to be basic to planning literature needs and priorities for the ATL Program. This information should then become part of the writer's assignment rather than charging the writer with determining purpose and user after the decision has been made to write the manual.

For The Guidebook: Guidance should be provided on how to prepare literature oriented to job performance of users, including design of manuals for more than one major user (e.g., commanders, supervisors, workers, instructors). Guidance should be provided on the design of manuals for flexibility of purpose (e.g., for initial learning and for later reference).

For Army Policy: The same manuals designed for presentation of general, topic-oriented information are not effective as instructional texts for new learners, as job aids for directing job performance, and as reference sources for experienced workers. Emphasis should be given to policy which recognizes the different functions of ATL and the design implications of these functions.